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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/964,910	09/27/2001	Kiyoshi Yamaura	112857-301	3249
29175	7590	06/15/2004	EXAMINER	
BELL, BOYD & LLOYD, LLC P. O. BOX 1135 CHICAGO, IL 60690-1135			YUAN, DAH WEI D	
			ART UNIT	PAPER NUMBER
			1745	
DATE MAILED: 06/15/2004				

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/964,910

Applicant(s)

YAMAURA ET AL.

Examiner

Dah-Wei D. Yuan

Art Unit

1745

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 3/31/04
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 8, 10-14 and 16-32 is/are pending in the application.
- 4a) Of the above claim(s) 27-32 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 8, 10-14 and 16-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 27 September 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

## Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
  - 2) ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

## Attachment(s)

- |   |   |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>03112002</u> . | 6) <input type="checkbox"/> Other: _____  |

Art Unit: 1745

**GAS DIFFUSION ELECTRODE AND FUEL CELL INCLUDING SAME**

Examiner: Yuan

S.N. 09/964,910

Art Unit: 1745

June 7, 2004

**Detailed Action**

1. The Applicant's amendment filed on March 31, 2004 was received. The title of the specification was amended. Claims 9,15 were cancelled. Claims 8,14,21 were amended.
2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on August 27, 2003.

***Information Disclosure Statement***

3. The information disclosure statement filed on March 11, 2002 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because copies of the foreign patent documents, JP 05166520, JP 2000003714 and EP 0226911 A1, and the paper entitled "carbon nanotube membranes for electrochemical energy storage and production" by Che et al. are not provided. It has been placed in the application file, but the information referred to therein has not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609 C(1).

***Specification***

4. The amendment filed on March 31, 2004 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: ... wherein the gas diffusion electrode comprises a thickness of about 5  $\mu\text{m}$  or less" in claim 8; "... wherein at least one of the first electrode and the second electrode comprises a thickness of about 5  $\mu\text{m}$  or less" in claims 14 and 21.

Applicant is required to cancel the new matter in the reply to this Office Action.

***Claim Rejections - 35 USC § 112***

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 14-26 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. The recitations "...wherein the gas diffusion electrode comprises a thickness of about 5  $\mu\text{m}$  or less" in claim 8 and "...wherein at least one of the first electrode and the second electrode comprises a thickness of about 5  $\mu\text{m}$  or less" in claims 14 and 21 are not supported in the instant disclosure. If applicant believes said terms are fully defined, it is requested that

applicant indicates column and line, and/or figure with number, in the specification. For the purpose of compact examination, the claims are interpreted as being directed to an electrode having a thickness of a few micrometers.

***Claim Rejections - 35 USC § 102***

7. The claim rejections under 35 U.S.C. 102(b) as anticipated by Fleckner et al. on claims 8,10,14,16-18,20,21,26 are withdrawn, because the independent claims 8,14,21 have been amended. The claim rejections under 35 U.S.C. 102(b) as anticipated by Hager et al. on claims 8,11,14,16,21,23 are withdrawn, because the independent claims 8,14,21 have been amended.

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claims 8,10,14,16-18,20,21,26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fleckner et al. (US 6,589,682 B1) as evidenced by Oyama et al. (US 2003/0048057 A1).

With respect to claims 8,10, Fleckner et al. teach a fuel cell comprising two gas diffusion layers (100,102) (gas diffusion electrode), which comprises carbon nanotubes to distribute reactant gas over the catalyst sites. Fleckner et al. further teach the nanotubes can be processed by a variety of methods including vapor deposition techniques. One in-situ technique which can

advantageously be used is chemical vapor deposition of various hydrocarbon compounds such as methane at controlled locations on a substrate using patterned catalytic islands. This combined synthesis and microfabrication technique allows a large number of ohmically contacted nanotube devices of controllable length to be placed on a single substrate. See Column 7, Lines 8-36; Column 9, Lines 32-46; Figures 6-8. It is well known that carbon nanotube is a fibrous carbon material as evidenced by Oyama et al. See Paragraph 4.

The disclosure of Fleckner et al. differs from Applicant's claims in that Fleckner et al. do not specifically disclose the thickness of the fibrous carbonaceous material. However, it would have been obvious to one of ordinary skill in the art to synthesize the nanotube for use as a gas diffusion electrode in a fuel cell to a thickness of a few micrometers, because Fleckner et al. teach the length of the nanotube is controllable by using the combined synthesis and microfabrication technique.

With respect to claims 14,16, Fleckner et al. teach a fuel cell comprising a Nafion membrane (92) (a perfluorosulfonate ionomer) disposed between two gas diffusion electrodes (100,102). The gas diffusion electrodes further comprise carbon nanotubes. See Column 7, Lines 8-36; Figures 6-8.

With respect to claims 17,18, Fleckner et al. teach the fuel cell further comprising a Pt/carbon ink by mixing 20 wt.% platinum on Vulcan XC-72R carbon with Nafion solution. See Column 8, Lines 39-58.

With respect to claim 20, the fuel is supplied through conduits (41) to the gas diffusion electrode (56) on the fuel side of the fuel cell whereas oxygen is supplied through conduits (43)

Art Unit: 1745

to the gas diffusion electrode (54) on the oxidant side of the fuel cell. See Figure 2, Column 5, Lines 40-67.

With respect to claim 21, Fleckner et al. teach a fuel cell comprising a Nafion membrane (92) (a perfluorosulfonate ionomer) and two gas diffusion electrodes (100,102). The gas diffusion electrodes further comprise carbon nanotubes. See Column 7, Lines 8-36; Figures 6-8.

With respect to claim 26, Fleckner et al. teach the fuel cell further comprising a Pt/carbon ink by mixing 20 wt.% platinum on Vulcan XC-72R carbon with Nafion solution. See Column 8, Lines 39-58.

10. Claims 8,11,14,16,21,23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hager et al. (US 6,013,371) in view of Fischer et al. (US 5,861,222) as evidenced by Kordesch et al. (Fuel Cells and Their Applications, VCH Publishers, Inc.)

With respect to claims 8,11, Hager et al. teach the use of vapor grown carbon fiber (VGCF) to fabricate separators and electrodes (gas diffusion electrodes) in a fuel cell. See Column 3, Line 62 to Column 4, Line 5; Column 9, Line 56 to Column 10, Line 6; Column 12, Lines 11-16.

However, Hager et al. do not teach the thickness of the gas diffusion electrode for use in a fuel cell. Fischer et al. teach the optimum thickness of the gas diffusion electrode is in a range of 5 to 100  $\mu\text{m}$ . See Column 4, Lines 51-51; Column 5, Lines 56-60. Therefore, it would have been obvious to one of ordinary skill in the art to use the vapor grown carbon fiber of Hager as

the gas diffusion electrode having a thickness of 5 to 100  $\mu\text{m}$ , because Fischer et al. teach the optimum thickness of the gas diffusion layer in a fuel cell is in a range of 5 to 100  $\mu\text{m}$ .

With respect to claims 14,16,21,23, Hager et al. teach the electrodes in a fuel cell can be made of vapor grown carbon fiber (VGCF) material. The VGCF material from Applied Sciences, Inc of Cedarville, OH is a discontinuous highly graphitic fiber with an unique annular morphology. The fuel cell inherently comprises proton conducting material (electrolyte) sandwiched between an anode and a cathode as evidenced by Kordesch et al. See pages 51-53. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. In re Robertson, 49 USPQ2d 1949 (1999).

11. Claims 12,13,19,22,24,25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fleckner et al. and Newman et al. as applied to claims 8,10,14,16-18,20,21,26 above, and further in view of Hager et al. (US 6,013,371).

With respect to claim 12, Fleckner et al. disclose gas diffusion electrodes comprising carbon nanotube material as described above in Paragraph 9. However, Fleckner et al. do not teach the fibrous carbonaceous material comprising a mixture of carbon nanotubes and vapor grown carbon fibers. Hager et al. teach the addition of vapor grown carbon fibers can enhance the mechanical performance of the resulting carbon-carbon composite. See Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been obvious to one of ordinary skill in the art to use of the mixture of carbon nanotube and vapor grown carbon fibers on the gas diffusion



electrode of Fleckner et al., because Hager et al. teach the addition of VGCF can improve mechanical performance of the components.

With respect to claim 22, Fleckner et al. disclose a fuel cell comprising a proton conductor disposed between a first electrode and a second electrode wherein both electrodes comprise a carbon nanotube material as described above in paragraph 9. However, Fleckner et al. do not teach the fibrous carbonaceous material comprising a mixture of carbon nanotubes and vapor grown carbon fibers. Hager et al. teach the addition of vapor grown carbon fibers can enhance the mechanical performance of resulting carbon-carbon composite. See Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been obvious to one of ordinary skill in the art to use of the mixture of carbon nanotube and vapor grown carbon fibers on the gas diffusion electrode of Fleckner et al., because Hager et al. teach the addition of VGCF can improve mechanical performance of the components.

With respect to claims 13,19,24,25, Fleckner et al. and Hager et al. disclose applicant's invention essentially as claimed, with the exception that the ratio between the carbon nanotube and the vapor grown carbon fibers in the mixture is not discussed. However, Hager et al. recognize the incorporation of vapor grown carbon fibers into the composite can provide a reinforcing effect on the mechanical property of the material. See Column 3, Lines 8-12; Column 3, Line 62 to Column 4, Line 5. Therefore, it would have been within the skill of the ordinary artisan to adjust the relative amounts of carbon nanotube and vapor grown carbon fiber in the composite depending on the strength requirement of the composite electrode in the fuel

cell. *Discovery of optimum value of result effective variable in known process is ordinarily within skill of art.* In re Boesch, CCPA 1980, 617 F.2d 272, 205 USPQ215.

***Response to Arguments***

12. Applicant's arguments filed on March 31, 2004 have been fully considered but they are not persuasive.

*Applicant's principle arguments are*

*(a) Neither Fleckner et al. nor Hager teaches the thickness of the at least one of the first electrode and the second electrode to be about 5  $\mu\text{m}$  or less;*

*(b) Oyama reference should be precluded as prior art.*

In response to Applicant's arguments, please consider the following comments.

(a) In the instant disclosure, the thickness of the electrode is ranging from about 2 to about 4  $\mu\text{m}$ . See Page 7, Lines 29-32. The recitations concerning the thickness of the electrode in claims 8,14,21 do not have the support in the specification;

(b) Oyama is used as a factual reference, which needs not antedate the filing date of the application. See MPEP § 2124.

***Conclusion***

13. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dah-Wei D. Yuan whose telephone number is (571) 272-1295. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

Art Unit: 1745

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dah-Wei D. Yuan  
June 8, 2004

A handwritten signature in cursive script, appearing to read "Dah-Wei D. Yuan", followed by a long horizontal flourish.